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New Light Source Setup for Angle Resolved Light Absorption measurement of PV samples

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***Abstract*—Here, we introduce measurements of angle resolved light absorption by PV cells, using broadband laser driven white light source with a bright, stable, broad spectral range and well collimated light.**

Keywords— absorption; collimated; reproducibility; laser

I. INTRODUCTION

The light absorption of solar cells under working conditions is affected by several factors. In particular, this absorption effect of PV is studied with different type of light sources. In our set up we have used a new type of broad band light source. In their paper D. T. Reindl, W. A. Beckman, and J. A. Duffie studied the effect of diffuse irradiation as function of irradiation angle [1]. C Protogeropoulos and A Zachariou described reflectance characteristics of PV modules using a visible light source [2]. R. Santbergen and R.J.C. van Zolingen studied the effect of light absorption on the temperature of the PV modules [3]. In our case, we have built a set-up that allows automatized, reliable measurements of the light absorption of solar cells as function of incidence angle with collimated light (with an angular divergence of about 0.1 °). Hence, this set-up has many advantages, such as, the spectrum and intensity of the light source remain constant and high respectively throughout the test and the rotation stage can move easily and accurately with the given range of angles. The light source used here provides bright illumination across the UV-VIS-NIR range (190nm to 2100 nm) together with high spatial and power stability. Moreover, the light source is well collimated by collection optics to give a stable and reliable power measurement

II. Methods

The whole measurement system consists of laser driven broad light source, rotation stage with a sample holder and current measurement transducer which is controlled by a LabVIEW controlled PC. The schematic diagram of the setup is shown in the Fig. 1. The UV filter was used just after the light source to remove the UV-C part for safety. The measurement room was kept at a temperature of 21 ℃ using an air conditioning system.

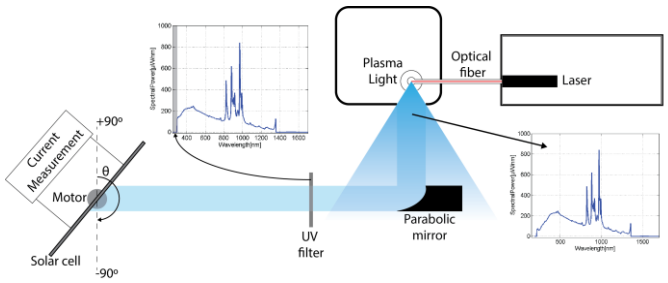

Fig. 1. Light absorption measurement setup of PV samples

III. Results and Summary

For the test we have used several PV modules. The samples varied with their glass structures or raw materials they are made of or the type of encapsulants used. The samples size are limited to less than 20 cm so that they will be stable on the holder while measurements. The setup used a laser driven light source which has high brightness, due to the excitation of very small plasma with a laser source. Moreover, it is a broad-spectrum light (190nm to 2100nm) with high spatial and power stability. This property of the light source gives a high SNR with a small integration time of the detector. We have calculated and checked the reproducibility of our measurement by repeatedly acquiring current at different angles (between +90 ° and -90 °) for a reference sample. After this reproducibility measurement then we have measured all the samples a number of times in the same way as a reference sample. In all the measurements we determined the highest relative standard deviation to be 0.7 % for angles of incidence larger than ±80 °.

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